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(71)Applicant : NEW JAPAN RADIO CO LTD

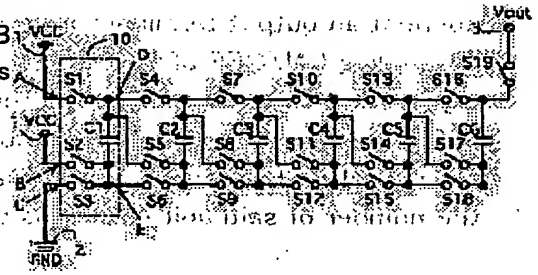
(72)Inventor : YAJIMA AKIRA
MAKIKO TAKAO

(54) VARIABLE BOOSTING CIRCUIT

(57)Abstract:

PROBLEM TO BE SOLVED: To materialize a variable boosting circuit and reducing the number of switches for use in an output terminal.

SOLUTION: A unit circuit 10 is composed of a condenser C1 and switches S1, S2 and S3 Two or more unit circuits are cascade-connected by connecting nodes A, B of another unit circuit to a node D of one unit circuit, and connecting a node E to a node C. The nodes A, B of the first-step circuit is connected to VCC and the node C to GND, as well as the node D of the last- step unit circuit is connected to the output terminal 3 through S19. The unit circuit is cascade-connected in N steps (N≥2 of even number) and, by switching S1 to S3 of each unit circuit and S19 on-off, one boosting voltage among multiples of N+1, N/2+1, 3 and 2 is selectively output.



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CLAIMS

[Claim(s)]
[Claim 1] A capacitor and the 1st switch on which the end was connected to the end of this capacitor, A unit circuit is constituted from the 2nd and 3rd switch on which the end was connected to the other end of said capacitor. And the other end of Node D and said capacitor is made [the other end of said 1st switch / Node A and the other end of said 2nd switch / Node B and the other end of said 3rd switch] into Node E for the end of Node C and said capacitor. Two or more unit circuits are cascaded by connecting Node C to the node D of a certain unit circuit for the nodes A and B of another unit circuit at Node E. Connect a high potential power supply terminal to the nodes A and B of the unit circuit of the first rank, and a low voltage power supply terminal is connected to Node C. By coming to connect an output terminal with the node D of the unit circuit of a tail end through the 4th switch, and controlling ON/OFF of the 1st, 2nd, and 3rd switch of each unit circuit, and said 4th switch The adjustable booster circuit characterized by making it output alternatively any one electrical potential difference in the twice of the electrical potential difference of said high potential power supply terminal, 3 times, N / 2+1 time, and N+1 time which carried out the pressure up from said output terminal when the number of said unit circuits is set to N (two or more even number).

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the adjustable booster circuit which enabled it to change output voltage.
[0002]
[Description of the Prior Art] This kind of adjustable booster circuit is shown in drawing 7 . As for C51 and C52, a capacitor, and S51-S58 are switches. As for a high potential power-source (VCC) terminal and 2, 1 is [a low voltage power-source (GND) terminal and 3] output terminals. A 3 time pressure up

and 2 double pressure up are possible in this booster circuit.

[0003] (Time [3] pressure-up actuation: Drawing 8) The switch S54 is fixed to OFF at the time of this 3 time pressure up.

[0004] (a) .. Switches S52, S53, S56, and S57 are made to turn on, and switches S51, S55, and S58 are made to turn off.

[0005] (b) .. Switches S52, S53, S56, and S57 are made to turn off, and switches S51, S55, and S58 are made to turn on.

[0006] If each switch is changed as shown in (a), it will become a circuit as shown in (a) of drawing 8 , and supply voltage VCC will be charged by capacitors C51 and C52 with the polarity of illustration. Next, if each switch is changed as shown in (b), it will become a circuit as shown in (b) of drawing 8 , the electrical potential difference of a capacitor C51 and the electrical potential difference of C52 will be added by like-pole nature to the electrical potential difference of a power supply terminal 1, and the electrical potential difference of 3VCC(s) will occur in an output terminal 3. Therefore, the electrical potential difference of stable 3VCC(s) can be taken out from an output terminal 3 by repeating the switch change condition of (a) of drawing 8 , and (b) by turns.

[0007] (2 double pressure-up actuation: Drawing 9) Switches S55 and S58 are fixed to OFF at the time of this 2 double pressure up, and it fixes switches S56 and S57 to ON or OFF.

[0008] (a) .. Switches S52 and S53 are turned on and switches S51 and S54 are made to turn off.

[0009] (b) .. Switches S52 and S53 are turned off and switches S51 and S54 are made to turn on.

[0010] If each switch is changed as shown in (a), it will become a circuit as shown in (a) of drawing 9 , and supply voltage VCC will be charged by the capacitor C51 with the polarity of illustration. Next, if each switch is changed as shown in (b), it will become a circuit as shown in (b) of drawing 9 , the electrical potential difference of a capacitor C51 will be added by like-pole nature to the electrical potential difference of a power supply terminal 1, and the electrical potential difference of 2VCC(s) will occur in an output terminal 3. Therefore, the electrical potential difference of stable 2VCC(s) can be taken out from an output terminal 3 by repeating the switch change condition of (a) of drawing 9 , and (b) by turns.

[0011]

[Problem(s) to be Solved by the Invention] However, switches S54 and S58 are needed in this booster circuit for the change of the capacitors C51 and C52 linked to an output terminal 3. When making a booster circuit in a semiconductor integrated circuit, since size becomes large compared with transistors, such as a logic gate, the transistor which functions as a switch will cause chip area increase, if the number of switches increases. Moreover, in the time of 2 double pressure up, one capacitor C51 does not contribute to a pressure up, but the use effectiveness of a capacitor is bad.

[0012] The purpose of this invention is offering the adjustable booster circuit which made pressure-up effectiveness high as suppressed chip area increase as the switch which changes the capacitor linked to an output terminal was unnecessary, and could contribute all capacitors to pressure-up actuation.

[0013]

[Means for Solving the Problem] The 1st switch by which, as for this invention for solving the above-mentioned technical problem, the end was connected to the end of a capacitor and this capacitor, A unit circuit is constituted from the 2nd and 3rd switch on which the end was connected to the other end of said capacitor. And the other end of Node D and said capacitor is made [the other end of said 1st switch / Node A and the other end of said 2nd switch / Node B and the other end of said 3rd switch] into Node E for the end of Node C and said capacitor. Two or more unit circuits are cascaded by connecting Node C to the node D of a certain unit circuit for the nodes A and B of another unit circuit at Node E. Connect a high potential power supply terminal to the nodes A and B of the unit circuit of the first rank, and a low voltage power supply terminal is connected to Node C. By coming to connect an output terminal with the node D of the unit circuit of a tail end through the 4th switch, and controlling ON/OFF of the 1st, 2nd, and 3rd switch of each unit circuit, and said 4th switch When the number of

said unit circuits was set to N (two or more even number), it was made to output alternatively any one electrical potential difference in the twice of the electrical potential difference of said high potential power supply terminal, 3 times, N / 2+1 time, and N+1 time which carried out the pressure up from said output terminal.

[0014]

[Embodiment of the Invention] [Gestalt of the 1st operation] drawing 1 is the circuit diagram of the adjustable booster circuit of the gestalt of operation of the 1st of this invention. For a capacitor, and S1-S19, as for a high potential power-source (VCC) terminal and 2, a switch and 1 are [C1-C6 / a low voltage power-source (GND) terminal and 3] output terminals. 10 is a unit circuit which consists of a capacitor C1 and switches S1-S3, and this adjustable booster circuit carries out six-step cascade connection (cascade connection) of this unit circuit 10. The nodes A and B were connected to the power supply terminal 1, and it connected Node C to the low voltage power supply terminal 2 respectively, and the unit circuit 10 of the first rank connects Node D to the nodes A and B of the unit circuit of the next step, and has connected Node E to the node C of the unit circuit of the next step. Moreover, the unit circuit of a tail end has connected the node D to an output terminal 3 through a switch S19.

[0015] A 7 times, 4 times, 3 times, and twice as many pressure up as this is possible by the change of switches S1-S19 in this booster circuit.

[0016] (Time [7] pressure-up actuation: Drawing 2 and drawing 3)

(a) .. Switches S1 and S3, S4, S6 and S7, S9, and S10, S12, S13, S15, S16 and S18 are made to turn on, and the remaining switch is made to turn off. By this, as shown in drawing 2 , supply voltage VCC is separately charged by each capacitors C1-C6.

[0017] (b) .. Each switch is changed to the above and reverse. As shown in drawing 3 , the series connection of the capacitors C1-C6 is carried out between a power supply terminal 1 and an output terminal 3 by this, and the electrical potential difference of 7VCC(s) by which the electrical potential difference VCC of a power supply terminal 1 was added to the electrical potential difference VCC of each capacitors C1-C6 by like-pole nature appears in an output terminal 3.

[0018] Therefore, the electrical potential difference of a pressure up is obtained 7 times stabilized in the output terminal 3 by changing the switch condition of drawing 2 , and the switch condition of drawing 3 by turns.

[0019] (Time [4] pressure-up actuation: Drawing 2 and drawing 4)

(c) .. After changing to the condition of drawing 2 , a switch S2, S4, and S6, S8, S10, S12, S14, S16, S18 and S19 are made to turn on, and the remainder is turned OFF. As this shows to drawing 4 , parallel connection of C4, C5, and C6 is respectively carried out to a capacitor C1, and C2 and C3, and series connection of these is carried out between a power supply terminal 1 and an output terminal 3, and the electrical potential difference of 4VCC appears in an output terminal 3.

[0020] Therefore, the electrical potential difference of a pressure up is obtained 4 times stabilized in the output terminal 3 by changing the switch condition of drawing 2 , and the switch condition of drawing 4 by turns. Since parallel connection of each two capacitors C1-C6 of every is carried out at this time, that pressure-up capacity becomes large and a big load can be borne.

[0021] (Time [3] pressure-up actuation: Drawing 2 and drawing 5)

(d) .. After changing to the condition of drawing 2 , a switch S2, S4, S6 and S7, S9, and S11, S13, S15, S16, S18 and S19 are made to turn on, and the remainder is turned OFF. As this shows to drawing 5 , parallel connection of C5 and C6 is respectively carried out to capacitors C1 and C2, and C3 and C4, and series connection of these is carried out between a power supply terminal 1 and an output terminal 3, and the electrical potential difference of 3VCC appears in an output terminal 3.

[0022] Therefore, the electrical potential difference of a pressure up is obtained 3 times stabilized in the output terminal 3 by changing the switch condition of drawing 2 , and the switch condition of drawing 5 by turns. Since parallel connection of each three capacitors C1-C6 of every is carried out at this time,

that pressure-up capacity becomes large, and a big load can be borne.

[0023] (2 double pressure-up actuation: Drawing 2 and drawing 6)

(e) . After changing to the condition of drawing 2 , a switch S2, S4, S6 and S7, S9, and S10, S12, S13, S15, S16, S18 and S19 are made to turn on, and the remainder is turned OFF. As this shows to drawing 6 , parallel connection of the capacitors C1-C6 is carried out, and series connection of these is carried out by like-pole nature between a power supply terminal 1 and an output terminal 3, and the electrical potential difference of 2VCC appears in an output terminal 3.

[0024] Therefore, the electrical potential difference of 2 double pressure up stabilized in the output terminal 3 is obtained by changing the switch condition of drawing 2 , and the switch condition of drawing 6 by turns. Since parallel connection of those all is carried out at this time, that pressure-up capacity becomes large and each capacitors C1-C6 can bear a big load.

[0025] In addition, although six steps of unit circuits 10 were cascaded and 7 times, 4 times, 3 times, and 2 double pressure up were realized above, if it is made eight steps, and 9 times, 5 times, 3 times, and 2 double pressure up make it ten steps, 11 times, 6 times, 3 times, and 2 double pressure up of them will become possible. That is, an N+1 time, N / 2+1 time, 3 times, and twice as many adjustable pressure up as this is realizable in this unit circuit by carrying out N stage (two or more even number) cascade connection of the unit circuit.

[0026]

[Effect of the Invention] As mentioned above, according to this invention, the switch which connects a capacitor to an output terminal can be managed with one piece. Moreover, by carrying out N stage (two or more even number) cascade connection of the unit circuit, an N+1 time, N / 2+1 time, 3 times, and twice as many adjustable pressure up as this can be realized, and it becomes usable at a wide range application. Furthermore, since pressure-up actuation can be presented with the capacitor of each stage without futility, pressure-up power also becomes large.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the circuit diagram of the booster circuit of the 1st operation gestalt.

[Drawing 2] It is the explanatory view of the charge to each capacitor of the circuit of drawing 1 .

[Drawing 3] It is the explanatory view of the 7 time pressure up of the circuit of drawing 1 .

[Drawing 4] It is the explanatory view of the 4 time pressure up of the circuit of drawing 1 .

[Drawing 5] It is the explanatory view of the 3 time pressure up of the circuit of drawing 1 .

[Drawing 6] It is the explanatory view of 2 double pressure up of the circuit of drawing 1 .

[Drawing 7] It is the circuit diagram of the conventional booster circuit.

[Drawing 8] It is the explanatory view of the 3 time pressure up of the circuit of drawing 7 .

[Drawing 9] It is the explanatory view of 2 double pressure up of the circuit of drawing 7.

[Description of Notations]

10: Unit circuit

[Translation done.]

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(71)出願人　000191238
新日本無線株式会社
東京都中央区日本橋横山町３番10号

(72)発明者　矢嶋　昭
埼玉県上福岡市福岡２丁目１番１号　新日本無線株式会社川越製作所内

(72)発明者　牧子　高雄
埼玉県上福岡市福岡２丁目１番１号　新日本無線株式会社川越製作所内

(74)代理人　100083194
弁理士　長尾　常明

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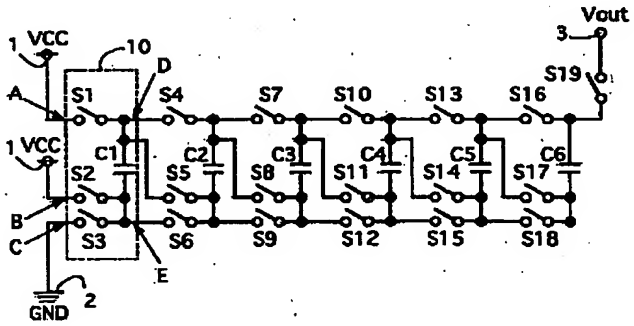
(54)【発明の名称】　可変昇圧回路

(57)【要約】
【課題】　可変昇圧回路を実現し、出力端子に対するスイッチ数を削減する。
【解決手段】　コンデンサＣ１、スイッチＳ１，Ｓ２，Ｓ３から単位回路１０を構成する。ある単位回路のノードＤに別の単位回路のノードＡ，Ｂを、ノードＣにノードＥを接続することにより２以上の単位回路を縦属接続する。初段の単位回路のノードＡ，ＢにＶＣＣを、ノードＣにＧＮＤを接続すると共に終段の単位回路のノードＤにＳ１９を介して出力端子３を接続する。単位回路をＮ段（Ｎ≧２の偶数）縦属接続し、各単位回路のＳ１～Ｓ３，Ｓ１９をオン／オフすることにより、Ｎ＋１倍、Ｎ／２＋１倍、３倍、２倍ののうちのいずれか１つの昇圧電圧を選択的に出力する。



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【特許請求の範囲】

【請求項１】コンデンサと、該コンデンサの一端に一端が接続された第１のスイッチと、前記コンデンサの他端に一端が接続された第２、第３のスイッチとから単位回路を構成し、且つ前記第１のスイッチの他端をノードＡ、前記第２のスイッチの他端をノードＢ、前記第３のスイッチの他端をノードＣ、前記コンデンサの一端をノードＤ、前記コンデンサの他端をノードＥとして、

ある単位回路のノードＤに別の単位回路のノードＡ、Ｂを、ノードＥにノードＣを接続することにより２以上の単位回路を縦属接続して、初段の単位回路のノードＡ，Ｂに高電位電源端子を接続し、ノードＣに低電位電源端子を接続し、終段の単位回路のノードＤに第４のスイッチを介して出力端子を接続してなり、

各単位回路の第１、第２，第３のスイッチ及び前記第４のスイッチのオン／オフを制御することにより、前記単位回路の数をＮ（２以上の偶数）としたとき、前記出力端子から前記高電位電源端子の電圧の２倍、３倍、Ｎ／２＋１倍、Ｎ＋１倍のうちのいずれか１つの昇圧した電圧を選択的に出力するようにしたことを特徴とする可変昇圧回路。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、出力電圧を切り替えることができるようにした可変昇圧回路に関するものである。

【０００２】

【従来の技術】図７にこの種の可変昇圧回路を示す。Ｃ５１，Ｃ５２はコンデンサ、Ｓ５１～Ｓ５８はスイッチである。１は高電位電源（ＶＣＣ）端子、２は低電位電源（ＧＮＤ）端子、３は出力端子である。本昇圧回路では、３倍昇圧と２倍昇圧が可能である。

【０００３】（３倍昇圧動作：図８）この３倍昇圧のときは、スイッチＳ５４はオフに固定しておく。

【０００４】(a)・・スイッチＳ５２，Ｓ５３，Ｓ５６，Ｓ５７をオンさせ、スイッチＳ５１，Ｓ５５，Ｓ５８をオフさせる。

【０００５】(b)・・スイッチＳ５２，Ｓ５３，Ｓ５６，Ｓ５７をオフさせ、スイッチＳ５１，Ｓ５５，Ｓ５８をオンさせる。

【０００６】(a)のように各スイッチを切り替えると、図８の(a)に示すような回路となり、コンデンサＣ５１，Ｃ５２に電源電圧ＶＣＣが図示の極性で充電される。次に(b)に示すように各スイッチを切り替えると、図８の(b)に示すような回路となり、電源端子１の電圧に対してコンデンサＣ５１の電圧とＣ５２の電圧が同極性で加算されて、出力端子３に３ＶＣＣの電圧が発生する。したがって、図８の(a)と(b)のスイッチ切替状態を交互に繰り返すことによって、安定した３ＶＣＣの電圧を出力端子３から取り出すことができる。

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【０００７】（２倍昇圧動作：図９）この２倍昇圧のときは、スイッチＳ５５，Ｓ５８をオフに固定し、スイッチＳ５６，Ｓ５７をオン又はオフに固定しておく。

【０００８】(a)・・スイッチＳ５２，Ｓ５３をオンし、スイッチＳ５１，Ｓ５４をオフさせる。

【０００９】(b)・・スイッチＳ５２，Ｓ５３をオフし、スイッチＳ５１，Ｓ５４をオンさせる。

【００１０】(a)のように各スイッチを切り替えると、図９の(a)に示すような回路となり、コンデンサＣ５１に電源電圧ＶＣＣが図示の極性で充電される。次に(b)に示すように各スイッチを切り替えると、図９の(b)に示すような回路となり、電源端子１の電圧に対してコンデンサＣ５１の電圧が同極性で加算されて、出力端子３に２ＶＣＣの電圧が発生する。したがって、図９の(a)と(b)のスイッチ切替状態を交互に繰り返すことによって、安定した２ＶＣＣの電圧を出力端子３から取り出すことができる。

【００１１】

【発明が解決しようとする課題】ところが、この昇圧回路では、出力端子３に接続するコンデンサＣ５１，Ｃ５２の切替用にスイッチＳ５４，Ｓ５８が必要となっている。昇圧回路を半導体集積回路内に作り込む場合、スイッチとして機能するトランジスタは論理ゲート等のトランジスタに比べてサイズが大きくなるので、スイッチ数が増大するとチップ面積増大を招く。また、２倍昇圧時では１個のコンデンサＣ５１が昇圧に寄与しておらず、コンデンサの利用効率が悪い。

【００１２】本発明の目的は、出力端子に接続するコンデンサを切り替えるスイッチが必要ないようにして、チップ面積増大を抑え、また昇圧動作に全部のコンデンサが寄与できるようにして昇圧効率を高くした可変昇圧回路を提供することである。

【００１３】

【課題を解決するための手段】上記課題を解決するための本発明は、コンデンサと、該コンデンサの一端に一端が接続された第１のスイッチと、前記コンデンサの他端に一端が接続された第２、第３のスイッチとから単位回路を構成し、且つ前記第１のスイッチの他端をノードＡ、前記第２のスイッチの他端をノードＢ、前記第３のスイッチの他端をノードＣ、前記コンデンサの一端をノードＤ、前記コンデンサの他端をノードＥとして、ある単位回路のノードＤに別の単位回路のノードＡ、Ｂを、ノードＥにノードＣを接続することにより２以上の単位回路を縦属接続して、初段の単位回路のノードＡ，Ｂに高電位電源端子を接続し、ノードＣに低電位電源端子を接続し、終段の単位回路のノードＤに第４のスイッチを介して出力端子を接続してなり、各単位回路の第１、第２，第３のスイッチ及び前記第４のスイッチのオン／オフを制御することにより、前記単位回路の数をＮ（２以上の偶数）としたとき、前記出力端子から前記高電位電

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源端子の電圧の２倍、３倍、Ｎ／２＋１倍、Ｎ＋１倍のうちのいずれか１つの昇圧した電圧を選択的に出力するようにした。

【００１４】

【発明の実施の形態】［第１の実施の形態］図１は本発明の第１の実施の形態の可変昇圧回路の回路図である。Ｃ１～Ｃ６はコンデンサ、Ｓ１～Ｓ１９はスイッチ、１は高電位電源（ＶＣＣ）端子、２は低電位電源（ＧＮＤ）端子、３は出力端子である。１０はコンデンサＣ１，スイッチＳ１～Ｓ３よりなる単位回路であり、本可変昇圧回路はこの単位回路１０を６段縦属接続（カスケード接続）したものである。初段の単位回路１０はそのノードＡ，Ｂを電源端子１に、ノードＣを低電位電源端子２に各々接続し、ノードＤを次段の単位回路のノードＡ，Ｂに、ノードＥを次段の単位回路のノードＣに接続している。また、終段の単位回路はそのノードＤをスイッチＳ１９を介して出力端子３に接続している。

【００１５】本昇圧回路では、スイッチＳ１～Ｓ１９の切り替えによって、７倍、４倍、３倍、２倍の昇圧が可能である。

【００１６】（７倍昇圧動作：図２と図３）

(a)・・スイッチＳ１，Ｓ３，Ｓ４，Ｓ６，Ｓ７，Ｓ９，Ｓ１０，Ｓ１２，Ｓ１３，Ｓ１５，Ｓ１６，Ｓ１８をオンさせ、残りのスイッチをオフさせる。これによって、図２に示すように各コンデンサＣ１～Ｃ６に個々に電源電圧ＶＣＣが充電される。

【００１７】(b)・・各スイッチを上記と逆に切り替える。これによって、図３に示すようにコンデンサＣ１～Ｃ６が電源端子１と出力端子３の間に直列接続され、各コンデンサＣ１～Ｃ６の電圧ＶＣＣに電源端子１の電圧ＶＣＣが同極性で加算された７ＶＣＣの電圧が出力端子３に現れる。

【００１８】よって、図２のスイッチ状態と図３のスイッチ状態を交互に切り替えることによって、出力端子３に安定した７倍昇圧の電圧が得られる。

【００１９】（４倍昇圧動作：図２と図４）

(c)・・図２の状態に切り替えた後、スイッチＳ２，Ｓ４，Ｓ６，Ｓ８，Ｓ１０，Ｓ１２，Ｓ１４，Ｓ１６，Ｓ１８，Ｓ１９をオンさせ残りをオフにする。これによって図４に示すようにコンデンサＣ１とＣ２、Ｃ３とＣ４，Ｃ５とＣ６が各々並列接続され且つこれらが電源端子１と出力端子３の間に直列接続され、４ＶＣＣの電圧が出力端子３に現れる。

【００２０】よって、図２のスイッチ状態と図４のスイッチ状態を交互に切り替えることによって、出力端子３に安定した４倍昇圧の電圧が得られる。このとき、各コンデンサＣ１～Ｃ６は２個ずつ並列接続されるので、その昇圧容量が大きくなり、大きな負荷に耐えることができる。

【００２１】（３倍昇圧動作：図２と図５）

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(d)・・図２の状態に切り替えた後、スイッチＳ２，Ｓ４，Ｓ６，Ｓ７，Ｓ９，Ｓ１１，Ｓ１３，Ｓ１５，Ｓ１６，Ｓ１８，Ｓ１９をオンさせ残りをオフにする。これによって図５に示すようにコンデンサＣ１とＣ２とＣ３、Ｃ４とＣ５とＣ６が各々並列接続され且つこれらが電源端子１と出力端子３の間に直列接続され、３ＶＣＣの電圧が出力端子３に現れる。

【００２２】よって、図２のスイッチ状態と図５のスイッチ状態を交互に切り替えることによって、出力端子３に安定した３倍昇圧の電圧が得られる。このとき、各コンデンサＣ１～Ｃ６は３個ずつ並列接続されるので、その昇圧容量が大きくなり、大きな負荷に耐えることができる。

【００２３】（２倍昇圧動作：図２と図６）

(e)・・図２の状態に切り替えた後、スイッチＳ２，Ｓ４，Ｓ６，Ｓ７，Ｓ９，Ｓ１０，Ｓ１２，Ｓ１３，Ｓ１５，Ｓ１６，Ｓ１８，Ｓ１９をオンさせ残りをオフにする。これによって図６に示すようにコンデンサＣ１～Ｃ６が並列接続され且つこれらが電源端子１と出力端子３の間に同極性で直列接続され、２ＶＣＣの電圧が出力端子３に現れる。

【００２４】よって、図２のスイッチ状態と図６のスイッチ状態を交互に切り替えることによって、出力端子３に安定した２倍昇圧の電圧が得られる。このとき、各コンデンサＣ１～Ｃ６はその全部が並列接続されるので、その昇圧容量が大きくなり、大きな負荷に耐えることができる。

【００２５】なお、以上では単位回路１０を６段縦属接続して、７倍，４倍，３倍，２倍昇圧を実現したが、８段にすると９倍，５倍，３倍，２倍昇圧が、１０段にすると１１倍，６倍，３倍，２倍昇圧が可能となる。つまり、この単位回路では、単位回路をＮ段（２以上の偶数）縦属接続することにより、Ｎ＋１倍、Ｎ／２＋１倍、３倍、２倍の可変昇圧が実現できる。

【００２６】

【発明の効果】以上から本発明によれば、コンデンサを出力端子に対して接続するスイッチは１個で済む。また、単位回路をＮ段（２以上の偶数）縦属接続することにより、Ｎ＋１倍、Ｎ／２＋１倍、３倍、２倍の可変昇圧が実現でき、広範囲の用途に使用可能となる。さらに、各段のコンデンサを無駄なく昇圧動作に供することができるので、昇圧電力も大きくなる。

【図面の簡単な説明】

【図１】第１の実施形態の昇圧回路の回路図である。

【図２】図１の回路の各コンデンサへの充電の説明図である。

【図３】図１の回路の７倍昇圧の説明図である。

【図４】図１の回路の４倍昇圧の説明図である。

【図５】図１の回路の３倍昇圧の説明図である。

【図６】図１の回路の２倍昇圧の説明図である。

【図７】　従来の昇圧回路の回路図である。

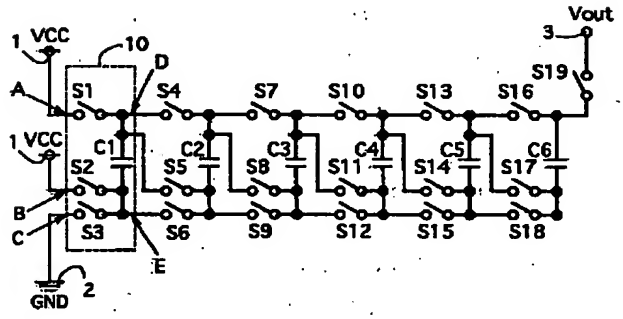
【図８】　図７の回路の３倍昇圧の説明図である。

【図９】　図７の回路の２倍昇圧の説明図である。

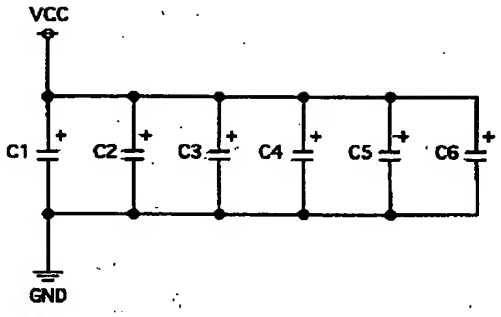
【符号の説明】

１０：単位回路

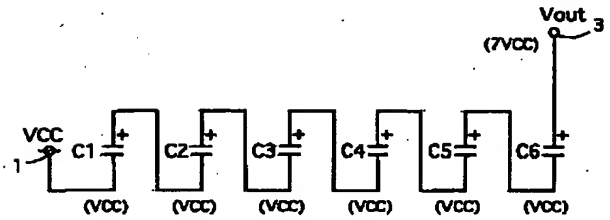
【図１】



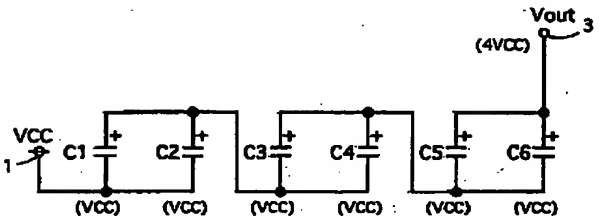
【図２】



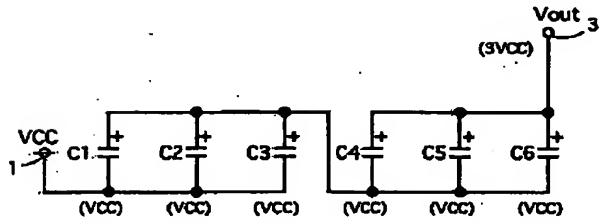
【図３】



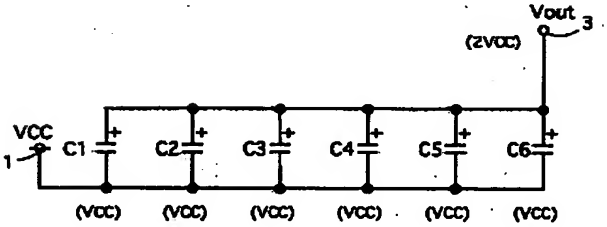
【図４】



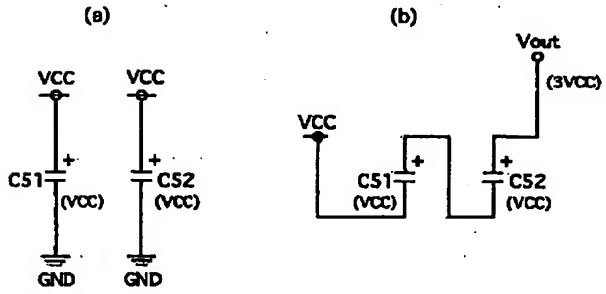
【図５】



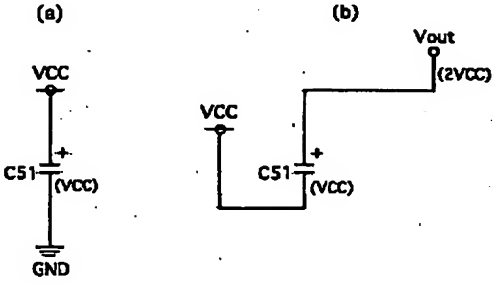
【図６】



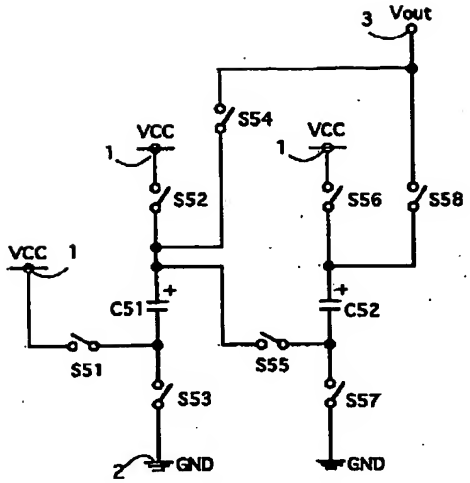
【図８】



【図９】



【図７】



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